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A Retrospective Analysis of Psychosocial Risk Factors Modulating Adolescent Alcohol Binge Drinking

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Key Words
Alcohol · Intoxication · Binge drinking · Adolescents · Coping · Unemployment

Abstract
Background/Aims: Adolescent alcohol binge-induced hospital admissions (BIHAs) are an increasing problem in Europe. We investigated whether psychosocial factors (e.g., drinking situations, drinking occasions and neighborhood unemployment) are associated with particularly risky patterns of alcohol or substance use. ***Method:*** We performed a systematic retrospective chart review of all the respective cases in 2003–2008 (n = 586; age range: 12–17 years) from both pediatric hospitals in the city of Dresden, Germany. ***Results:*** The vast majority of adolescent BIHAs were associated with drinking together with peers at weekend parties. Compared to this 'typical' drinking pattern, adolescents drinking 'atypically' (i.e., drinking either alone, to cope or despite the fact that the next day was a school/work day) more often had already used alcohol and illegal substances before and were more often diagnosed with substance use disorders and other mental disorders prior to BIHA. The unemployment rate in the patients' neighborhood was positively related to the incidence proportion of adolescent BIHAs in the respective subdistricts (r_s = 0.61). ***Conclusion:*** Adolescent atypical drinking may indicate an increased risk for the development of alcohol and substance use disorders. This information is quickly accessible and can alert clinicians to initiate psychosocial aftercare; their infrastructure should address the strong relation between BIHA probability and neighborhood unemployment rates.

Introduction

The frequency of adolescent alcohol binge-induced hospital admissions (BIHAs) for pediatric inpatient treatment remarkably increased over the last years in many Western countries [1–4]. In the year 2000, 9,500 such admissions occurred in Germany. Since then the numbers have kept rising each year, amounting to 26,700 in 2012 [5]. Excessive alcohol consumption has detrimental ef-

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fects on health and well-being [6]. Already in adolescents, it is modulated by complex interactions between genetic factors, the environment and psychiatric comorbidity [7] and is associated with alcohol use disorders (AUDs [8]), injuries and death [9] as well as cognitive and emotional impairments [10–12]. Ongoing development of higher brain structures and psychosocial functions in adolescents may be specifically disrupted by alcohol intoxication, as evidenced by long-lasting changes in the prefrontal cortex [13, 14]. Such changes are accompanied by impaired cognitive abilities and impaired decision making, which enhance reward-seeking behavior and risky choices. These, in turn, promote the development of AUDs [15–19].

While excessive alcohol consumption in adolescence, especially binge drinking, has been comprehensively investigated (for a review, see Courtney and Polich [20]), acute alcohol intoxication with subsequent hospital admission (i.e., BIHA) as an extreme form of bingeing has gained scientific attention only during the last years [3, 4, 21–27]. An important question concerning the significance of extreme bingeing remains open: does a single BIHA indicate that psychosocial development is at risk, e.g., by the development of AUDs? Alternatively, may it merely represent a by-product of adolescent experimenting in the process of learning low-risk, culturally accepted drinking behavior? Or can both be true in different patients? In longitudinal studies on alcohol consumption during the transition from adolescence to early adulthood, the observed trajectories vary significantly, some leading to severe AUDs, while others indicate maturing out [28–31]. Hence, to discern BIHA patients with a high versus moderate risk for the later development of AUDs, we analyzed social and environmental contexts possibly modulating this risk based on information which is readily accessible in the emergency room.

We based our analysis on several assumptions concerning the psychosocial context of normative versus atypical drinking in adolescents. Moderate drinking that does not affect social functioning is culturally accepted in Western societies and is, by definition, normative [32]. Although violating the law, most adolescents start experimenting with alcohol at about the age of 15 years [33], almost exclusively when having fun together with friends at weekend parties [34], which can be described as a 'typical' drinking pattern for adolescents based on a statistical norm. In contrast, drinking alone, drinking to cope with conflicts, drinking in the daytime or drinking although the next day is a school or work day appears to be 'atypical' behavior in adolescents.

We contrasted these atypical drinking patterns to widely acknowledged risk factors promoting AUD development such as a history of previous drinking [35, 36], previous alcohol-related treatments [29, 37, 38], multiple drug use [39] as well as the presence of attention deficit hyperactivity disorder (ADHD) and other mental disorders [38, 40, 41].

Socioeconomic status is often positively correlated with alcohol use [42, 43], but underprivileged neighborhoods can be a chronic stressor influencing the prevalence of alcohol problems in adolescence. However, the overall influence is still unclear in both adults [44] and children [45]. Therefore, we tested the association between neighborhood unemployment and BIHA incidence. To answer these questions, we performed a local in-depth analysis of adolescent BIHAs by identifying and analyzing all the respective cases occurring in the city of Dresden, Germany, over a 6-year period.

Subjects and Methods

Patient Sample

Cases were recruited from both pediatric inpatient treatment units in Dresden, i.e., from the University Hospital Carl Gustav Carus and the Municipal Hospital Dresden-Neustadt. Since these two hospitals together cover pediatric inpatient care of all the Dresden inhabitants below the age of 18 years (n = approx. 66,000), we are confident that we missed only few cases. Using the electronic patient administration system, we identified all patients admitted between January 1, 2003, and December 31, 2008, whose ICD-10 diagnoses included F10.0 (acute alcohol intoxication) or T51.0 (external cause of morbidity and mortality: toxic effects of ethyl alcohol). No other inclusion criteria were applied. The only exclusion criterion was lacking documentation of the blood alcohol concentration (BAC) on admission. Five patients celebrating their 18th birthday (i.e., reaching the age of consent and legal drinking age in Germany) were included and counted as aged 17 years, although they were one day past their 18th birthday.

Acquisition of Patient Data

We conducted a systematic retrospective chart review of all cases and extracted data on patient characteristics (e.g., sex and age), prior admissions for alcohol intoxication (defined as the number of past documented alcohol-related hospital admissions), prior drinking (defined as having ever used alcohol before the current intoxication event), substance use (defined as having ever used illegal substances before the current intoxication event) as well as the social context of drinking and drinking patterns (described below). This information was not completely documented for all patients. If available, narrative free-text notes by clinical staff in the medical records were coded by a trained rater. For the analysis of local unemployment rates and the occurrence of previous alcohol-related admissions, only data on Dresden inhabitants (89.6% of all cases) were included. Therefore, the sample sizes for the analyses differ according to the variable.

Classification of Drinking Measures and Patterns

Blood alcohol levels were determined from venous blood samples on admission and are expressed in milligrams percent of full blood (e.g., 80 mg% is equivalent to 0.08% or 0.8‰). Clinical signs of alcohol intoxication were documented by the emergency physician using the Glasgow Coma Scale, which can vary between a maximum score of 15 (unimpaired eye opening, verbal and motor reaction) and a minimum score of 3 (deeply comatose).

Regarding drinking patterns, narrative information was coded grouping subjects deductively into clusters of patterns based on patients' assertions recorded by clinical staff. For drinking situations, the following clusters were derived: drinking in private premises together with adolescent friends (named by 60.4% of the patients), drinking in private premises together with adult family members (1.2%), drinking in public places including clubs or bars (14.8%) and drinking alone (8.7%). The remaining 14.9% were categorized as 'other' or 'unknown'. We contrasted drinking alone ('alone' pattern) with all other categories. As for drinking occasions, the following clusters were derived: partying with friends (named by 55.6% of the patients), drinking at a public event (31%), partying with family (1.2%), drinking at a school party or on a school trip (2.4%), drinking out of boredom (2.4%) and drinking associated with social conflicts (9.9%); 23.2% were categorized as 'other' or 'unknown'. We contrasted drinking associated with social conflicts with all other categories, assuming that it was intended to cope with conflicts ('cope' pattern). Concerning drinking despite the fact that the next day was a school or work day, we contrasted cases in which patients were admitted the night before a school or work day – implying that they very likely missed these obligations ('absenteeism' pattern; true for 16.7% of the patients) – with cases in which the next day was a Saturday, Sunday, public holiday or school holiday (83.3%). Individual vacations from work could not be accounted for. Concerning drinking during daytime ('daytime' pattern), any time of admission between noon and 7 p.m. was considered to represent drinking early during the day (true for 13.9% of the patients).

Analysis of the Relation between Psychosocial Variables and Risks for AUDs

We related the independent variables 'alone', 'cope', 'absenteeism' and 'daytime' to factors known to modulate the risk for the later development of AUDs (previous alcohol use, previous BIHAs, concomitant intoxication with illegal substances, a known history of substance use or mental disorders other than AUDs, as well as ADHD), BAC and clinical signs of intoxication as dependent variables.

Analysis of BIHA Incidence Proportion in Relation to Neighborhood Psychosocial Characteristics

The city of Dresden is divided into 14 districts subdivided into 61 subdistricts, the latter being considered to represent neighborhoods. Relevant statistical data were provided by the Statistical Information Service of the city of Dresden at the sub-district level. For all the Dresden inhabitants of our sample (n = 525), we calculated the incidence proportion of BIHAs for every subdistrict by dividing the number of cases by the total number of adolescents aged 10–17 years living in this subdistrict. The unemployment rate for a subdistrict was approximated by calculating the ratio between the total of unemployed persons and the total of persons between the ages of 18 and 65 years having their primary residence in this subdistrict. The percentage of one-parent families in a subdistrict was also provided by the Statistical Information Service and was closely related to the respective unemployment rate ($r_s = 0.89$, $p < 0.001$), which is why we did not consider the latter measure as an independent influential factor. Unemployment rates were analyzed for interrelations with BIHA incidence proportions, BAC on admission and clinical signs of intoxication by calculating Pearson's correlation coefficients. Due to missing data in the chart notes, we were unable to perform a systematic analysis of how unemployment in the individual patients' families affected the probability of BIHAs.

We also explored whether BIHA incidence proportions were more similar between adolescents living in adjacent subdistricts (despite the fact that these differed in unemployment rates) or between the inhabitants of subdistricts with comparable unemployment rates (which were widely dispersed over the city's area). For this purpose, we employed a two-level mixed-effects linear regression model [46]. The observations about BIHA incidence and unemployment rates in a subdistrict were clustered within the districts (level two). The within-effect of the unemployment rate is represented by the subdistrict centered rate and the between-effect by the average across a subdistrict. The two-level mixed-effect was estimated by maximum likelihood.

The study protocol was approved by the Ethics Committee of the Technische Universität Dresden.

Results

We identified 586 cases of BIHA in Dresden adolescents within 6 years. Taking into account the number of Dresden adolescents between 10 and 18 years, the overall incidence proportion of adolescent BIHAs amounted to 1.76% in 6 years and ranged between 0 and 4.17% across the city's subdistricts. Twenty-nine patients (6.4% of the subgroup having their residency in Dresden) experienced more than 1 BIHA but were counted only once when calculating incidence proportions; 8% of the sample had consumed at least 1 illegal substance, namely, cannabinoids (n = 17), amphetamines (n = 6), opiates (n = 4), benzodiazepines (n = 1) or barbiturates (n = 1). A history of substance use disorders prior to BIHA was documented in 3.4%, ADHD in 3.2% and other mental disorders in 4.8% of the subjects. BACs were available in 581 cases and ranged between 16 and 312 mg% with a mean (SD) of 153 (52) mg%. The mean age of the patients was 16.2 (1.2) years and 61.4% were male.

Relation between Atypical Drinking Patterns and Risk Factors for AUDs

The frequencies of atypical drinking patterns in relation to age, gender and risk factors for AUDs are described in table 1. The drinking patterns alone, cope and absenteeism, but not daytime, were significantly associated with several risk factors.

Table 1. Relation between atypical drinking patterns and known risk factors for alcohol problems based on 581 cases of BIHA

	Alone			Cope			Absenteeism			Daytime		
	n[a]	test score	p	n[a]	test score	p	n[a]	test score	p	n[a]	test score	p
Gender	51 (10.2%)	$\chi^2 = 0.04$	0.881	58 (12.8%)	$\chi^2 = 7.94$	0.006[e]	97 (16.7%)	$\chi^2 = 0.12$	0.743	82 (14.0%)	$\chi^2 = 0.14$	0.711
Age	51 (10.2%)	U = 10,922.0	0.461	58 (12.8%)	U = 11,274.0	0.822	97 (16.7%)	U = 20,525.5	0.027[c]	82 (14.0%)	U = 14,615.5	<0.001[d]
BAC on admission	51 (10.3%)	T = 1.32	0.193	58 (12.8%)	T = 3.27	0.001[d]	97 (16.7%)	T = –0.46	0.645	79 (13.6%)	T = 0.43	0.668
Glasgow Coma Scale score on admission	51 (10.8%)	U = 9,810.0	0.282	57 (13.2%)	U = 8,972.0	0.050	91 (16.5%)	U = 20,328.5	0.545	76 (13.8%)	U = 17,420.5	0.599
One or more previous BIHA[b]	47 (10.5%)	$\chi^2 = 2.55$	0.312	51 (12.6%)	$\chi^2 = 0.04$	0.999	81 (15.5%)	$\chi^2 = 0.99$	0.606	82 (14.0%)	$\chi^2 = 0.001$	0.975
Used alcohol prior to BIHA	18 (13.0%)	$\chi^2 = 5.76$	0.018[c]	24 (20.3%)	$\chi^2 = 0.30$	0.645	33 (20.6%)	$\chi^2 = 7.35$	0.007[c]	82 (14.0%)	$\chi^2 = 0.27$	0.875
Used illegal substances of abuse	51 (10.2%)	$\chi^2 = 27.59$	<0.001[c]	58 (12.8%)	$\chi^2 = 17.63$	<0.001[c]	97 (16.7%)	$\chi^2 = 11.75$	0.001[c]	42 (7.2%)	$\chi^2 = 0.16$	0.685
Documented diagnosis of SUDs other than alcohol	51 (10.2%)	$\chi^2 = 23.63$	<0.001[c]	58 (12.8%)	$\chi^2 = 2.10$	0.156	97 (16.7%)	$\chi^2 = 8.42$	0.008[c]	82 (14.0%)	$\chi^2 = 0.26$	0.608
Documented ADHD	51 (10.2%)	$\chi^2 = 0.72$	0.502	58 (12.8%)	$\chi^2 = 1.02$	0.490	97 (16.7%)	$\chi^2 = 0.31$	0.782	82 (14.0%)	$\chi^2 = 1.45$	0.229
Documented diagnosis of mental disorders other than SUDs or ADHD	51 (10.2%)	$\chi^2 = 36.12$	<0.001[c]	58 (12.8%)	$\chi^2 = 8.69$	0.008[c]	97 (16.7%)	$\chi^2 = 12.05$	0.002[c]	82 (14.0%)	$\chi^2 = 1.30$	0.253

SUD = Substance use disorder. [a] Number of subjects (with percentages in parentheses) to whom this drinking pattern applied and for whom information concerning the respective column and row was at all available. Due to incomplete documentation, the same number of cases can result in slightly different percentages. [b] Included are only subjects having their place of residence in Dresden. [c] Higher or more often. [d] Lower or less often. [e] More females.

Relation between Estimated Unemployment Rates and Extreme Bingeing

The relation between estimated unemployment rates and BIHA incidence proportions for all 61 subdistricts is depicted in figure 1. The correlation was statistically significant ($r_s = 0.61$, $p < 0.001$), explaining 37% of the variance. BIHA incidence proportions were more similar between subdistricts with the same unemployment rate, even if they lay distantly, than between neighboring subdistricts which tended to have different unemployment rates. The mixed-effects linear regression model employed to test this assumption revealed a considerable association between BIHA incidence and estimated unemployment rate within the subdistricts ($\beta = 0.43$; 95% CI: 0.08–0.78; $p = 0.016$), whereas the within-district effect was not significant ($\beta = 0.39$; 95% CI: –0.11 to 0.89; $p = 0.126$). Unlike the BIHA incidence proportion, none of the intoxication severity characteristics was significantly associated with the estimated unemployment rate in the subdistrict of residence (BAC: $r_s = -0.018$, $p = 0.710$; Glasgow Coma Scale: $r_s = 0.028$, $p = 0.571$).

Discussion

The main results of this study are that (1) adolescents drinking 'atypically' showed more risk factors for the later development of AUDs than subjects who followed the typical adolescent behavior of drinking for fun together with friends at weekend parties and that (2) unemployment rates in the subdistricts of residence were positively related to BIHA incidence proportion but not to measures of intoxication severity.

The atypical drinking patterns of drinking alone, drinking to cope, drinking although the next day is a school or work day and early drinking resulting in admission during daytime occurred less often than their opposite behavioral patterns, i.e., drinking for reward at evening weekend parties together with friends, which we defined as a typical drinking pattern. Our knowledge about typical drinking behavior is limited to cases of BIHA. Also in the general population, drinking to have fun is common in adolescence [34]. Although enhancement and social motives are also associated with risky drinking patterns [47], it is obvious that only a small proportion of these young people end up in hospital. The alone, cope and absenteeism patterns were closely associated with several risk factors for the development of AUDs such as prior alcohol or illegal substance use, substance use dis-

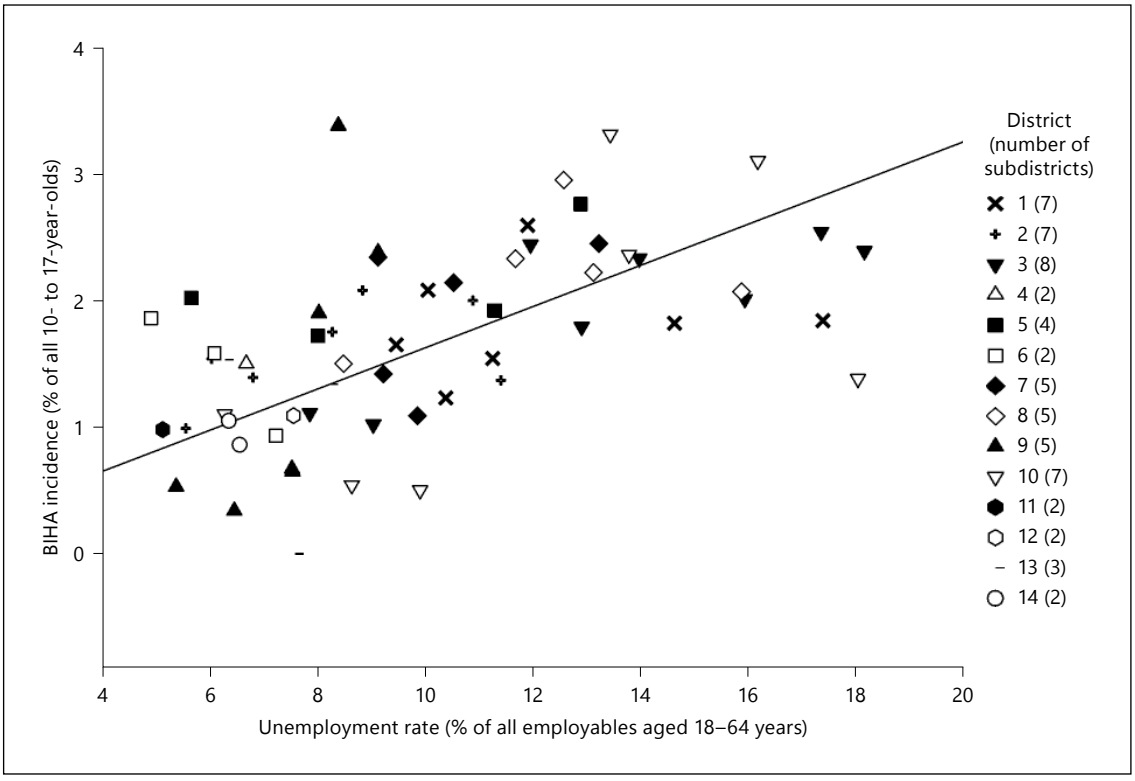

Fig. 1. Relation between estimated unemployment rate and incidence proportion of BIHA for each of the 61 statistical subdistricts of the city of Dresden among 581 cases of alcohol-intoxicated adolescents. $R^2 = 0.37$. Symbols represent the 14 districts, each of them subdivided into 2–8 subdistricts.

orders and other mental disorders. Other researchers also reported that drinking to cope represents an unusual drinking motif for adolescents and is connected to problematic drinking in adolescents and college students [34]. Our results confirm previous findings on gender aspects regarding drinking to cope. We found that more girls reported coping motives than boys. In a study examining motives for first-time alcohol consumption, Kuntsche and Müller [47] found that girls more often reported that they used alcohol because they were depressed or to cheer up when they had problems. Coping motives were also associated with binge drinking. Concerning drinking alone, Bourgault and Demers [48] found that adults drinking alone were at increased risk for alcohol-related problems only if large quantities were consumed. Gonzalez et al. [49] simultaneously studied these two aspects in a sample of young adults (aged 18–20 years), showing that drinking to cope was associated with drinking heavily while being alone.

Contrary to our expectations, we found no difference in the frequencies of alone, cope and absenteeism patterns between the subjects with and those without previous episodes of BIHA. Possible interpretations are that this is a false-negative finding due to insufficient test power, since only 29 patients experienced 1 or more previous BIHAs, or that we missed recurrent BIHAs because they occurred outside the city of Dresden. A third possible reason relates to the mean age at first diagnosis of AUDs, which is 17.6 years in Germany according to Wittchen et al. [50]. Therefore, many subjects in our study might simply have been too young to accumulate more than 1 BIHA within the 6-year observation period.

Not all deviations from the adolescent majority's drinking behavior appear to be relevant, as, in our sample, drinking during school/working hours (daytime) was not significantly correlated to any of the above risk factors. This is in line with a recent international study reporting that drinking frequency, but not the time of day, was related to alcohol problems [51]. We conclude that the 'atypical' drinking patterns of drinking alone or to cope as well as absenteeism represent relevant early markers for the risk for developing an AUD, possibly not only in

the context of BIHAs but also during any adolescent alcohol consumption.

Such individual psychological determinants of drinking habits cannot, however, explain why the BIHA incidence proportion varied considerably between the subdistricts, ranging between 0 and more than 4% of the adolescent population. Therefore, we were also interested in the effect of environmental influences. We were able to analyze unemployment rates on the city's subdistrict level, which were highly correlated to BIHA incidence proportion but not to BAC or clinical signs of intoxication.

To analyze the relation between BIHAs and unemployment more in depth, we employed multilevel analyses and found that the BIHA incidence proportion in a subdistrict was more strongly associated with its unemployment rate than with the BIHA incidence proportion of the neighboring subdistricts. This observation suggests that unemployment in the immediate neighborhood might be a more important determinant of bingeing than drinking behavior of peers living in a different region of the same district, although they putatively attend the same schools, public services and regional shops. We also tried to analyze the effect of unemployment in the individual patients' families, but these efforts were thwarted by incomplete documentation of parents' employment status.

We found only few previous studies describing the relation between unemployment and binge drinking. These are highly heterogeneous regarding the general design, setting and measures of drinking and unemployment and do not agree with our results. In a cross-sectional survey, Svensson and Hagquist [42] analyzed neighborhood unemployment rates and found that high unemployment was related to less frequent drinking and less frequent binge drinking among adolescents aged 15–16 years. Humensky [43] found that individual (not neighborhood) high parental education and income were significantly associated with higher rates of binge drinking among the parents' adolescent/young-adult offspring in a national longitudinal survey. While these two observational studies rather suggest a protective role of unemployment, Costello et al. [52] found that the intervention of giving financial support to disadvantaged Native American families protected these families' children from the development of AUDs 13 years later. A recent review paper on the relation between general measures of low childhood socioeconomic status and later drinking concluded that there is little evidence supporting such an association [45]. A major difference between this literature and our study refers to the measure of drinking, since we investigated an extreme form of bingeing which was not specifically considered in previous studies. When discussing these mixed results, it is also important to bear in mind that low socioeconomic status is not the same as unemployment. Our overall conclusion is that neighborhood unemployment may be associated with adolescent drinking in a way that cannot be described by unidimensional models.

Such an assumption brings up the question of causality, which is notoriously difficult to answer by epidemiological research methods. In our study, we found that unemployment rates and the percentage of one-parent families in the subdistricts were closely related to each other, which is why the latter parameter showed the same significant correlation with BIHAs as did the unemployment rate. This makes us believe that neighborhood unemployment itself is not the active factor increasing the risk for adolescent bingeing, but is merely a marker indicating the presence of a yet unknown causal factor.

Obvious limitations of this study include, first, the design as a retrospective chart review, which constrained our search for putative risk markers to what was routinely documented in standard pediatric care. Therefore, we cannot exclude that we underestimated the incidence of risk factors. Second, we have no information about the distribution of the observed risk factors in other patient populations; a comparison with patients admitted to hospital due to other reasons than alcohol intoxication would allow estimations about the relative risk of intoxicated patients. Third, we do not know how closely adolescent extreme bingeing is reflected by the number of BIHAs, since many confounding factors may influence whether or not rescue services are at all called if a drunken adolescent passes out or needs help for other reasons. Fourth, this is a retrospective, cross-sectional study. Its preliminary results are derived from exploratory analyses without correcting for multiple testing and therefore ask for confirmation by longitudinal follow-up studies to find out whether atypical drinking actually predicts later development of AUDs in the same individuals.

These results bear implications for pediatric health care and addiction prevention strategies. Since brief emergency room interventions in adults are effective to reduce future drinking [53], BIHAs might just as well be a chance for secondary prevention. Given the limited resources in prevention services, our data give a first suggestion on how to identify adolescents who are at an especially high risk for AUDs. While taking the patients' history, pediatricians should focus on the respective information on why, together with whom and when adoles-

cents drank to intoxication. Despite the special situation of being admitted to hospital and potential social desirability biases, this information is quickly accessible. It can alert clinicians to intensify addiction-specific diagnostic efforts and recommend psychosocial aftercare for adolescents drinking atypically. The remarkably tight relation between neighborhood unemployment rates and BIHA incidence proportion is one of the few empirical findings supporting the often suspected link between low socioeconomic status and alcohol problems. Living in an underprivileged neighborhood may represent, or indicate, a chronic stressor. Neurobiological research suggests that childhood environmental stress exposure can foster a process increasing the vulnerability to later alcohol problems, which takes place years before adolescents actually have their first drink [7]. Together these findings strengthen the cause for early preventive efforts in at-risk adolescents and suggest markers to identify them.

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References

1 Bundeszentrale für Gesundheitliche Aufklärung: Alkoholkonsum der Jugendlichen in Deutschland 2004 bis 2007. Ergebnisse der Repräsentativbefragungen der Bundeszentrale für gesundheitliche Aufklärung, Köln. Köln, Bundeszentrale für gesundheitliche Aufklärung, 2011.

2 Hibell B, Andersson B, Ahlström S, Balakireva O, Bjarnason T, Kokkevi A, et al: The 1999 ESPAD Report. Stockholm, Swedish Council for Information on Alcohol and Other Drugs, CAN, Council of Europe, Co-Operation Group to Combat Drug Abuse and Illicit Trafficking in Drugs (Pompidou Group), 2000.

3 Kuzelova M, Hararova A, Ondriasova E, Wawruch M, Riedel R, Benedekova M, et al: Alcohol intoxication requiring hospital admission in children and adolescents: retrospective analysis at the University Children's Hospital in the Slovak Republic. Clin Toxicol (Phila) 2009;47:556–561.

4 Schöberl S, Nickel P, Schmutzer G, Siekmeyer W, Kiess W: Acute ethanol intoxication among children and adolescents. A retrospective analysis of 173 patients admitted to a university children hospital (in German). Klin Padiatr 2008;220:253–258.

5 Statistisches Bundesamt: Aus dem Krankenhaus entlassene vollstationäre Patienten (einschliesslich Sterbe- und Stundenfälle) 2003 bis 2012: F10.0 – Psychische und Verhaltensstörungen durch Alkohol. Akute Intoxikation (akuter Rausch). Wiesbaden, Statistisches Bundesamt, 2014. https://www.destatis.de/DE/ZahlenFakten/GesellschaftStaat/Gesundheit/Krankenhaeuser/Tabellen/DiagnoseAlkoholJahre.html.

6 Okoro CA, Brewer RD, Naimi TS, Moriarty DG, Giles WH, Mokdad AH: Binge drinking and health-related quality of life: do popular perceptions match reality? Am J Prev Med 2004;26:230–233.

7 Zimmermann US, Blomeyer D, Laucht M, Mann KF: How gene-stress-behavior interactions can promote adolescent alcohol use: the roles of predrinking allostatic load and childhood behavior disorders. Pharmacol Biochem Behav 2007;86:246–262.

8 Nelson CB, Wittchen HU: DSM-IV alcohol disorders in a general population sample of adolescents and young adults. Addiction 1998;93:1065–1077.

9 Rehm J, Taylor B, Patra J: Volume of alcohol consumption, patterns of drinking and burden of disease in the European region 2002. Addiction 2006;101:1086–1095.

10 Brown SA, McGue M, Maggs J, Schulenberg J, Hingson R, Swartzwelder S, et al: A developmental perspective on alcohol and youths 16–20 years of age. Pediatrics 2008;121(suppl 4): S290–S310.

11 Hanson KL, Medina KL, Padula CB, Tapert SF, Brown SA: Impact of adolescent alcohol and drug use on neuropsychological functioning in young adulthood: 10-year outcomes. J Child Adolesc Subst Abuse 2011;20: 135–154.

12 Tapert SF, Granholm E, Leedy NG, Brown SA: Substance use and withdrawal: neuropsychological functioning over 8 years in youth. J Int Neuropsychol Soc 2002;8:873–883.

13 Monti PM, Miranda R Jr, Nixon K, Sher KJ, Swartzwelder HS, Tapert SF, et al: Adolescence: booze, brains, and behavior. Alcohol Clin Exp Res 2005;29:207–220.

14 Witt ED: Research on alcohol and adolescent brain development: opportunities and future directions. Alcohol 2010;44:119–124.

15 Bava S, Tapert SF: Adolescent brain development and the risk for alcohol and other drug problems. Neuropsychol Rev 2010;20:398–413.

16 Crews F, He J, Hodge C: Adolescent cortical development: a critical period of vulnerability for addiction. Pharmacol Biochem Behav 2007;86:189–199.

17 Guerri C, Pascual M: Mechanisms involved in the neurotoxic, cognitive, and neurobehavioral effects of alcohol consumption during adolescence. Alcohol 2010;44:15–26.

18 Medina KL, McQueeny T, Nagel BJ, Hanson KL, Schweinsburg AD, Tapert SF: Prefrontal cortex volumes in adolescents with alcohol use disorders: unique gender effects. Alcohol Clin Exp Res 2008;32:386–394.

19 Moss HB: Special section: alcohol and adolescent brain development. Alcohol Clin Exp Res 2008;32:427–429.

20 Courtney KE, Polich J: Binge drinking in young adults: data, definitions, and determinants. Psychol Bull 2009;135:142–156.

21 Van Zanten E, Van der Ploeg T, Van Hoof JJ, Van der Lely N: Gender, age, and educational level attribute to blood alcohol concentration in hospitalized intoxicated adolescents: a cohort study. Alcohol Clin Exp Res 2013;37: 1188–1194.

22 Binner C, Selinski S, Barysch MJ, Polcher C, Schormann W, Hermes M, et al: Munich Oktoberfest experience: remarkable impact of sex and age in ethanol intoxication. Arch Toxicol 2008;82:933–939.

23 Bitunjac K, Saraga M: Alcohol intoxication in pediatric age: ten-year retrospective study. Croat Med J 2009;50:151–156.

24 Meyer S, Steiner M, Mueller H, Nunold H, Gottschling S, Gortner L: Recent trends in the burden of alcohol intoxication on pediatric in-patient services in Germany. Klin Padiatr 2008;220:6–9.

25 Stolle M, Sack PM, Spieles H, Thomasius R: Acute ethanol intoxication among children and adolescents in Hamburg, Germany (in German). Bundesgesundheitsblatt Gesundheitsforschung Gesundheitsschutz 2010;53:910–916.
26 Weinberg L, Wyatt JP: Children presenting to hospital with acute alcohol intoxication. Emerg Med J 2006;23:774–776.
27 Woolfenden S, Dossetor D, Williams K: Children and adolescents with acute alcohol intoxication/self-poisoning presenting to the emergency department. Arch Pediatr Adolesc Med 2002;156:345–348.
28 Jefferis BJ, Power C, Manor O: Adolescent drinking level and adult binge drinking in a national birth cohort. Addiction 2005;100:543–549.
29 Pitkanen T, Kokko K, Lyyra AL, Pulkkinen L: A developmental approach to alcohol drinking behaviour in adulthood: a follow-up study from age 8 to age 42. Addiction 2008;103(suppl 1):48–68.
30 Quigley LA, Marlatt GA: Drinking among young adults. Alcohol Health Res World 1996;20:185–192.
31 Sloan F, Grossman D, Platt A: Heavy episodic drinking in early adulthood and outcomes in midlife. J Stud Alcohol Drugs 2011;72:459–470.
32 Kuendig H, Plant MA, Plant ML, Miller P, Kuntsche S, Gmel G: Alcohol-related adverse consequences: cross-cultural variations in attribution process among young adults. Eur J Public Health 2008;18:386–391.
33 Vega WA, Aguilar-Gaxiola S, Andrade L, Bijl R, Borges G, Caraveo-Anduaga JJ, et al: Prevalence and age of onset for drug use in seven international sites: results from the International Consortium of Psychiatric Epidemiology. Drug Alcohol Depend 2002;68:285–297.
34 Kuntsche E, Knibbe R, Gmel G, Engels R: Why do young people drink? A review of drinking motives. Clin Psychol Rev 2005;25:841–861.
35 Harford TC, Grant BF, Yi HY, Chen CM: Patterns of DSM-IV alcohol abuse and dependence criteria among adolescents and adults: results from the 2001 National Household Survey on Drug Abuse. Alcohol Clin Exp Res 2005;29:810–828.
36 McBride O, Cheng HG: Exploring the emergence of alcohol use disorder symptoms in the two years after onset of drinking: findings from the National Surveys on Drug Use and Health. Addiction 2011;106:555–563.
37 Lewinsohn PM, Rohde P, Seeley JR: Alcohol consumption in high school adolescents: frequency of use and dimensional structure of associated problems. Addiction 1996;91:375–390.
38 Rohde P, Lewinsohn PM, Kahler CW, Seeley JR, Brown R: Natural course of alcohol use disorders from adolescence to young adulthood. J Am Acad Child Adolesc Psychiatry 2001;40:83–90.
39 Hicks BM, Iacono WG, McGue M: Consequences of an adolescent onset and persistent course of alcohol dependence in men: adolescent risk factors and adult outcomes. Alcohol Clin Exp Res 2010;34:819–833.
40 Wilens TE, Martelon MK, Joshi G, Bateman C, Fried R, Petty C, Biederman J: Does ADHD predict substance use disorders? A 10-year follow-up study of young adults with ADHD. J Am Acad Child Adolesc Psychiatry 2011;50:543–553.
41 Falk DE, Yi HY, Hilton ME: Age of onset and temporal sequencing of lifetime DSM-IV alcohol use disorders relative to comorbid mood and anxiety disorders. Drug Alcohol Depend 2008;94:234–245.
42 Svensson M, Hagquist C: Adolescents alcohol-use and economic conditions: a multilevel analysis of data from a period with big economic changes. Eur J Health Econ 2010;11:533–541.
43 Humensky JL: Are adolescents with high socioeconomic status more likely to engage in alcohol and illicit drug use in early adulthood? Subst Abuse Treat Prev Policy 2010;5:19.
44 Kuntsche E, Rehm J, Gmel G: Characteristics of binge drinkers in Europe. Soc Sci Med 2004;59:113–127.
45 Wiles NJ, Lingford-Hughes A, Daniel J, Hickman M, Farrell M, Macleod J, et al: Socio-economic status in childhood and later alcohol use: a systematic review. Addiction 2007;102:1546–1563.
46 Snijders TAB, Bosker RJ: Multilevel Analysis: An Introduction to Basic and Advanced Multilevel Modeling. Thousand Oaks, Sage, 1999.
47 Kuntsche E, Müller S: Why do young people start drinking? Motives for first-time alcohol consumption and links to risky drinking in early adolescence. Eur Addict Res 2012;18:34–39.
48 Bourgault C, Demers A: Solitary drinking: a risk factor for alcohol-related problems? Addiction 1997;92:303–312.
49 Gonzalez VM, Collins RL, Bradizza CM: Solitary and social heavy drinking, suicidal ideation, and drinking motives in underage college drinkers. Addict Behav 2009;34:993–999.
50 Wittchen HU, Behrendt S, Höfler M, Perkonigg A, Lieb R, Bühringer G, et al: What are the high risk periods for incident substance use and transitions to abuse and dependence? Implications for early intervention and prevention. Int J Methods Psychiatr Res 2008;17(suppl 1):S16–S29.
51 Room R, Mäkelä P, Benegal V, Greenfield TK, Hettige S, Tumwesigye NM, et al: Times to drink: cross-cultural variations in drinking in the rhythm of the week. Int J Public Health 2012;57:107–117.
52 Costello EJ, Erkanli A, Copeland W, Angold A: Association of family income supplements in adolescence with development of psychiatric and substance use disorders in adulthood among an American Indian population. JAMA 2010;303:1954–1960.
53 Carey KB, Scott-Sheldon LA, Carey MP, DeMartini KS: Individual-level interventions to reduce college student drinking: a meta-analytic review. Addict Behav 2007;32:2469–2494.